INSTITUTE FOR CREATIVE TECHNOLOGIES GENESIS

Dr. Michael R. Macedonia, Richard D. Lindheim, and Dr. William R. Swartout

Introduction

The computer and Internet revolutions have substantially changed the direction of entertainment from delivery in a mass medium such as television to a mass customized experience via the Web and personal computers. However, the art of entertainment still requires stories, characters, and direction to make the experience meaningful and enjoyable. The U.S. Army faces the same challenge of adapting to the changes brought about through the mass marketing of supercomputing via platforms such as Sony PlayStation 2, Microsoft Xbox, and low-cost 3-D graphics.

There is also an urgent requirement for representing the human dimensions of war and conflict to provide training for the difficult decisionmaking problems our soldiers must face. Our experiences in Kosovo, Bosnia, and Afghanistan have shown that we need troop leaders who can handle the dilemmas posed by ethnic and social strife.

To provide such expertise, we must develop interface technologies such as natural-dialogue systems and intelligent agents that can simulate real-world problems. A 1997 study initiated by Anita Jones, then Director of Defense Research and Engineering, documented this need. Early in 1999, the Army leadership recognized a need for a major transformation of our forces to overcome the limitations of our current simulation technologies. Effecting this transformation requires developing new training and simulation systems to deal with future conflicts that leverage the capabilities of both the entertainment industry and academia.

The U.S. Army and DOD selected the University of Southern California (USC) as a strategic partner in the development of the Institute for Creative Technologies (ICT) because of USC's unique confluence of scientific capabilities and entertainment-industry relationships, which the Army deemed necessary for simulation leadership.

Prime Objective

The prime objective, as reaffirmed by Dr. A. Michael Andrews II, Deputy Assistant Secretary of the Army for Research and Technology and Chief Scientist of the Army, is to build a special partnership with the entertainment industry and academia.

Some of USC's unique qualifications arise from its location in Los Angeles, CA, hub of both the entertainment and aerospace industries. USC's qualifications further arise from its standing as a leading private research university and from the capabilities and stature of its component units and the working relationships they have developed with industry. For example, USC's top-ranked School of Cinema-Television grew side-by-side with the entertainment industry and continues to maintain close ties with it.

Under the auspices of the U.S. Army Simulation, Training and Instrumentation Command (STRICOM), USC established the ICT to develop the art and technology for providing synthetic experiences so compelling that participants react as if the simulations are real. In other words, ICT will provide verisimilitude—the quality or state of appearing to be true to synthetic experiences. The remainder of this article addresses one of these experiences—the Mission Rehearsal Exercise (MRE).

Mission Rehearsal Exercise

The MRE seeks to create a virtual-reality training environment in which soldiers will confront dilemmas that force them to make decisions in real time under stressful and conflicting circumstances. By allowing soldiers to see the consequences of their actions and decisionmaking skills in a simulator, the Army expects to better prepare its troops for dealing with similar dilemmas in the real world.

Since the end of the Cold War, the need for this kind of training has grown more acute because the variety of U.S. military operations has expanded enormously. In addition to conventional combat operations, U.S. military personnel frequently undertake a broad spectrum of missions that include peacekeeping operations, disaster-relief efforts, and noncombatant evacuations. Because these actions may require troops to deploy to virtually any location across the globe, providing advance training tailored to a wide variety of specific situations presents a daunting challenge.

Technical And Creative Team

Building the MRE system required assembling a diverse group of individuals and organizations with a broad range of talents. On the technical side, artificial intelligence researchers from USC/Information Sciences Institute (ISI) and USC/ICT created the automated reasoning and emotion modeling technology for the virtual humans. Audio researchers from USC's Integrated Media Systems Center created the immersive sound system and mixed and synchronized the effects and background sounds. Researchers from USC/ISI worked with AT&T's Next-Gen TTS (text to speech) speech synthesis system to create the most natural-sounding output. Finally, programmers and system developers experienced in creating real-time graphics tweaked the graphics system to provide acceptable performance.

To create the content for the MRE system, we needed an art director to design the environment's overall look; actors to serve as models for the virtual humans; and artists to model the animated characters, buildings, and environmental details.

Entertainment Industry

As the MRE development team worked on conceptualizing the MRE

simulation, a core divergence emerged as to how the Army, computer scientists, and entertainment people viewed the project. The entertainment people usually took an approach diametrically opposed to that of established scientific and military procedures. This is because entertainment people who work on simulations focus on the project's concept, theme, and story, shaping these elements to create the simulation's desired impact.

The Army's concept of story, however, differs considerably from that of the entertainment industry. What the Army considers a story, Hollywood labels an event list. A sequence of events does not itself create a story; a story requires linking events in a way that builds to a dramatic climax.

To date, simulations have, at best, made rudimentary use of character despite the critical importance that entertainment veterans place on this component. Yet any simulation for training people to work with one another in decisionmaking tasks must, by definition, place a premium on realistically depicting how individuals—even simulated ones—react to each other. Given the technical challenges involved and the high priority placed on implementing the capability, integrating character into the MRE simulation proved to be the project team's most difficult task.

The MRE Story

In the MRE, we seek Hollywood's influence most strongly in the rich story structure that guides, but does not completely determine, how our simulation unfolds. A good story sequences events so that emotions and tensions build and ebb. Plot twists and surprises maintain interest and involvement. The MRE uses story structure to build toward the dilemmas the trainee must resolve, offering different paths through the structure to reflect the different options the trainee can choose, thereby making it possible to see vividly the consequences of each decision.

For example, in our demonstration, the computer generates all the scenario's characters except for the trainee, a young first lieutenant. The first lieutenant has been instructed to rendezvous with his troops at a staging point before proceeding to help quell civil unrest occurring in a small town. The action unfolds as follows:

Surprise. When the first lieutenant arrives at the staging area, his platoon sergeant informs him that one of his High Mobility Multipurpose Wheeled Vehicles has collided with a local civilian car. The first lieutenant sees a small boy on the ground, seriously injured, the boy's frantic mother kneeling beside him.

Dilemma. Should the first lieutenant continue with his mission or stop, render aid, and arrange for a medical evacuation (MEDEVAC)?

Complication. A TV cameraman shows up and starts filming. Any mistake the first lieutenant makes could appear on the international news.

Complication. If the first lieutenant decides to arrange for a MEDEVAC via helicopter, the MRE may challenge him by relaying a radio call from troops already in town that reports intensifying unrest, shots fired, and a request for assistance.

Dilemma. Should the first lieutenant split his forces, sending some ahead while keeping others behind to help with the MEDEVAC, or should he keep his unit intact?

When confronted with these choices, the trainee may receive assistance from the virtual platoon sergeant. Because sergeants usually possess substantially more field experience than new first lieutenants, the Army teaches its entry-level officers to listen to the advice their sergeants offer. The virtual sergeant thus embodies Army doctrine and coaches the first lieutenant toward the most appropriate course of action.

Technology Goals

When we began developing the MRE system, we knew we would need to push the technology's boundaries in several areas to attain the kind of compelling, immersive experience we desired. Although we sought to achieve advances in particular areas, we also recognized that much of the experience's immersiveness would come from combining components that had thus far never been integrated. Further, we felt that integrating these components would grant us a better understanding of the technology and how the basic research should proceed in individual areas.

Thus, we wanted to make the MRE system fully integrated as early as possible while continuing to enhance the capabilities of some components. These concurrent goals presented a dilemma: You can't integrate components still in development. We resolved this dilemma by adopting a hybrid approach to system development. This allowed us to create an integrated system that used rudimentary versions of some capabilities, which acted as placeholders until more sophisticated capabilities became available.

Taking a hybrid approach also allowed us to introduce new technologies where they would make the most difference, while saving us effort in areas where simple techniques would suffice. Hybrid solutions also let us create a complete mission rehearsal scenario so that we could assess how it works as a whole, without having to solve all the subproblems in the most general way. We expect to incrementally improve the MRE system over time by replacing simple solutions for control, speech, and sound with more sophisticated techniques as our research in these areas progresses.

Note: Portions of this article were reprinted from "Forging a New Simulation Technology at the ICT," from the January 2001 issue of COMPUTER magazine.

DR. MICHAEL R. MACEDONIA is the Chief Scientist and Technical Director at STRICOM. He is a graduate of the U.S. Military Academy and has a Ph.D. in computer science.

RICHARD D. LINDHEIM is the Executive Director, Institute for Creative Technologies. He has a B.S. in electronic engineering from the University of Redlands and completed postgraduate studies in telecommunications and engineering at USC. Lindheim is the author of several publications, including two textbooks on television.

DR. WILLIAM R. SWARTOUT is the Director of Technology, Institute for Creative Technologies, and a Research Associate Professor at USC. He received his bachelor's degree from Stanford University and his M.S. and Ph.D. in computer science from the Massachusetts Institute of Technology.
